HETEROSTYLY IN PEMPHIS ACIDULA Forst. (LYTHRACEÆ) IN TANZANIA

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Abstract : *Pemphis acidula* from Tanzania was found to be distylic. The two floral forms differ in style length, stamen length, anther length and pollen size. In nature, the two forms were found to be represented roughly in equal numbers. Pollination studies indicated that the two forms were self-incompatible and self pollinations were sterile.

Résumé : L'hétérostylie est présente chez *Pemphis acidula* de Tanzanie. Les deux formes florales diffèrent par la longueur du style, de l'étamine, de l'anthère et la taille du pollen. Dans la nature, les deux formes se retrouvent à peu près en nombre égal. L'étude de la pollinisation a montré que chacune d'elles est auto-incompatible et auto-stérile.

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INTRODUCTION

Heterostyly means the presence of two or three floral forms in the same taxon. The forms differ in style length, anther length, position of stamens, size of stigmas, stigmatic papillæ, size, sculpture, colour, and contents of pollen grains and in physiological reaction of pollen and carpellary tissue (Ornduff, 1974).

Darwin (1877) demonstrated that heterostyly is generally associated with an incompatibility system which allows only certain fertilization to take place. It has been recorded in 24 families of the flowering plants and the family *Rubiaceæ* contains the largest number of heterostylous taxa (Ornduff, 1974). Both distylic and tristylic conditions have been reported in the family *Lythraceæ* (Solbrig, 1970).

Pemphis, a tropical genus, consists of two species, i.e., *P. acidula*, paleotropical species found especially on beaches and *P. madagascariensis* (Baker) Koehne, a native of the mountains of southwest Madagascar. In Tanzania *P. acidula* occurs along the coastal area (fig. 1). Lewis & Rao (1971) and Lewis (1975) reported distyly in this taxon from Malaysia and east Africa respectively. However, data on measurements of style length from the east African material were not given. In the present

study of the Tanzanian material, morphological characters and the compatibility relations of the two floral forms of *P. acidula* have been investigated. Further genetic studies are in progress.

MATERIAL AND METHODS

The specimens used in this study were collected from various localities in and around Dar es Salaam (fig. 1, *1*). Measurements for style and anther lengths were made using fresh material. For pollen grain size (both polar and equatorial axes) 100 measurements in each case were made after staining with cotton blue. Incompatibility tests were carried out in the laboratory by keeping the floral branches in plastic pots containing water. Crosses between different forms and within forms were made.

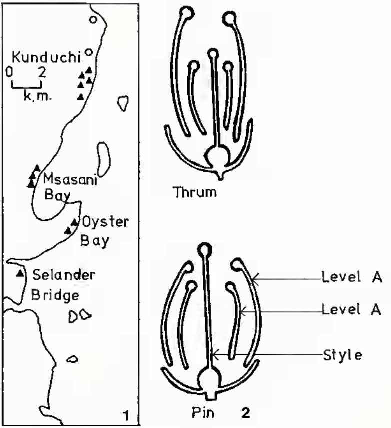


Fig. 1. — 1, Map of study; 2, style length and stamen length of the two floral forms.

After 24 hours, flowers were harvested and fixed in 1:3 acetic alcohol. The styles were cut longitudinally, stained with acid fuchsin and assessed for incompatibility qualitatively.

Pollen germination was carried out by using the hanging drop method. The culture medium consisted of agar (0.8 %), gelatin (0.5 %) and 2 %, 5 %, 10 %, 20 %, and 40 % of sucrose. It was smeared on a cover glass and pollen grains were dusted on the smear. The cover glass was then inverted on a cavity slide with 2-3 drops of water in it. The set up was made airtight by sealing with vaseline. At intervals of 12 hours and 24 hours the pollen were observed and any pollen tubes were measured.

RESULTS

The results of the present investigation are summarized in Tables 1, 2 and figures 1, 2, 3 and 4. In *P. acidula*, two forms were found in natural populations confirming the earlier reports of LEWIS & RAO (1971) and LEWIS (1975). The two forms are distinctive in relation to their style and anther lengths. From Table 1, it is clear that the distribution

Table 1 : POPULATION STUDIES

LOCALITY	PIN	THRUM	χ^2*	THRUM / PIN
Selander Bridge	3	4	1.3125	0.75
Kunduchi............	31	35	0.2424	0.90
Msasani	3	0	1.00	0
Total.............	37	39	2.5547	0.974

(*) The χ^2 values are a test of departure from 1 : 1 ratio.

of the two forms is not exactly in 1:1 ratio, but the difference is not significant statistically. The ratio of thrum to pin in the populations examined is approximately equal to 1. This is an indication that the distribution of thrum to pin in natural population is roughly 1:1 ratio. Calculated differentials (Table 2) for pin and thrum anthers differ remarkably.

Differential is calculated by dividing the difference between the levels ' A ' and ' B ' anther lengths by the level ' A ' anther length.

From Table 3, it is clear that the pollen also show dimorphism. Thrum pollen are larger than the Pin and this is in line with BAKER (1945, 1955), LEWIS & RAO (1971) and LEWIS (1975) in other dimorphic species.

From the Table 6 it is apparent that the two forms are self incompatible and self pollinations were sterile.

Table 2 : MEAN MEASUREMENTS FOR THE ANTHER AND THE STYLE (mm)

LOCALITY	STYLE	ANTHER		DIFFERENTIALS	PLANTS EXAMINED	SEEDS PER CAPSULE
		LEVEL A	LEVEL B	d/D		
Selander Bridge	4.00 ± 0.13	2.875 ± 0.25	2.25	0.2608	4	20-24
Msasani..................	4.92 ± 0.22	3.00	2.00	0.31427	3	
Kunduchi	4.858 ± 0.22	3.00 + 0.53	2.00	0.333	31	
Hotel Africana	4.55	2.06				
Ras Kiramoni	4.22	1.92				
$\bar{X}$	2.564					
Kunduchi	1.08 ± 0.3	4.38	3.2	0.270	35	25-30
Selander Bridge	1.433 ± 0.53	5.00	3.833	0.233	3	
$\bar{X}$		4.7				

Both the pin and thrum pollen germinated at different rates in 5 %, 10 %, 20 % sucrose solution (fig. 2, *4*; 4, *8*).

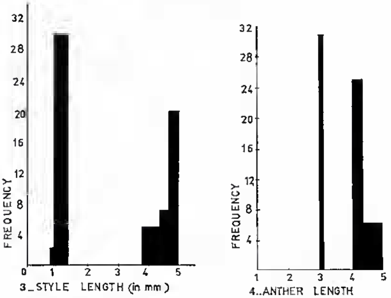


Fig. 2. — **3**, Style length distribution; **4**, Anther length distribution.

Table 3 : Comparison of the polar and equatorial axes of pollen grain

Flower Form	Equatorial	Polar
Pin	34.64 µm ± 0.3	39.91 µm ± 0.26
Thrum	36.18 µm ± 0.14	42.06 µm ± 1.1

Table 4 : Length of stigmatic papillæ

Pin	11.5-13.8 µm
Thrum	16.1-18.4 µm

Table 5 : Length of pollen tube in sucrose solution

Flower Form	Concentration of Sucrose				
	2 %	5 %	10 %	20 %	40 %
Pin		10.5 µm	11.0 µm	13.0 µm	
Thrum..................		13.2 µm	14.5 µm	13.9 µm	

Table 6 : Pollination experiments

Cross	No. of Pollination	Seed Setting
Pin × Thrum	10	Normal
Thrum × Pin	10	Normal
Pin Self	10	No Seed
Thrum Self.....................	10	No Seed

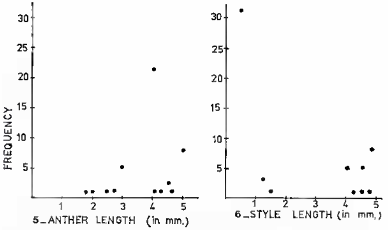


Fig. 3. — **5**, Scatter diagram for anther length distribution along the coast of Tanzania; **6**, Scatter diagram for style length distribution along the coast of Tanzania.

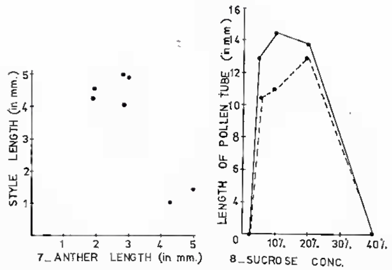


Fig. 4. — **7**, Relationship between anther length and style length; **8**, Potentiality of pollen to germinate in sucrose solutions.

DISCUSSION

From the present study, it is clear that populations of *P. acidula* along the Tanzanian coast have separated into two forms as indicated by the bi-modal distribution (fig. 2).

The bi-modal distribution of the style and anther lengths confirms the disruptive selection which has occurred in this species as reported by Lewis (1975). It has favoured the pin and thrum forms and thus eliminated the intermediates. Other selection forces are operating which favour distylic condition by elimination of the level ' B ' anthers (fig. 1, *2*). The anthers of the thrum are under directional selection (level ' A ' anthers) and all those below 4 mm are eliminated. It appears that for pin form, stabilizing selection is acting and the level ' A ' anthers are 3 mm (fig. 2, *4*). Thoday (1972) reported that after disruptive selection, directional selection follows and this is probably what has happened in *P. acidula*.

The difference in differentials (Table 2) indicates different responses to natural selection forces. The smaller differentials for thrum indicate raised level ' B ' anther while the larger differentials for pin indicate reduced level ' B ' anthers. This confirms Lewis & Rao (1971) observations from Malaysia.

The incompatibility in this taxon seems to be physiologically and genetically controlled and as demonstrated by Lewis (1954) in *Primula* it could be due to a supergene. It appears that the thrum pollen has a capacity to synthesize more proteins than the pin pollen (Table 4). The

inability of pollen to germinate on its own stigma could be due to a physiological reaction between carpellary tissue and pollen.

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